Design and Analysis of Drum Brake

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Abstract: A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum shaped part called a drum brake. The brake drum is a critical component that experiences high temperatures and develop thermal stresses during application of brakes. In addition, the application of Shoe Pressure gives rise to mechanical loads. So the analysis takes into account both the thermal stresses and mechanical stresses together. Brakes in cars and trucks are safety parts.The energy absorbed by brakes is dissipated in the form of heat. This heat is dissipated in the surrounding atmosphere to stop the vehicle. Generally, safety parts of cars and trucks are brakes, the common material are used for drum brake is cast iron.

KEYWORDS: Brake Drum, Automobile, Mechanical Properties

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1. INTRODUCTION

Brake drum was invented by Louis Renault in 1902. In the first brake drums, levers and rods and cables operated the shoes mechanically. From the mid-1930's, oil pressure in a small wheel cylinder and pistons operated by the brakes, though small vehicles continued with purely mechanical systems for decades. Some designs have two wheel cylinders. The shoes in brake drums wear thinner, and brakes required regular adjustment until the introduction of self-adjusting brake drums in 1950's.

The brake drum is used widely on road vehicles and consists of a drum attached to the rotating wheel. The drum has an internal machined cylindrical surface. Inside the drum and protected from the environment are two shoes lined with friction material which can be pivoted to make a forced contact with the internal cylindrical surface. A drum brake unit consists of two brake shoes mounted on a stationary backing plate. When the brake pedal is pressed, a hydraulically activated wheel cylinder pushes the shoes out to contact a rotating drum which creates friction and slows the vehicle. As the pedal is released, return springs retract the shoes to their original position.

Drum brakes were the first types of brakes used on motor vehicles. Nowadays, over 100 years after the first usage, drum brakes are still used on the rear wheels of most vehicles. The drum brake is used widely as the rear brake particularly for small car and motorcycle.

2. LITERATURE RIVIEW

[1] L.SRAVANI

This paper describe that the brake drum is experienced with high temperatures and develop thermal stresses during application of brakes. In addition, the application of shoe pressure gives rise to mechanical loads. So the analysis takes into account both the thermal stresses and mechanical stresses together. Requirements not only in performance but also in comfort, and working lifetime are high and rising. The brake pad with the friction material, the counter body and caliper, can be modeled. This project we design the model of drum brake (drum, & pads) in solid works 2018 and structural and thermal analysis are performed in ansys work bench software.

[2] K. Gowthami.

This paper describe that the drum brake uses the concept of friction to decelerate. During the brake operation heat is ejected out this causes damage to the brake. In this condition the drum material should possess a high thermal conductivity, thermal capacity and high strength. A thermal analysis of different materials such as aluminium alloy, cast iron and stainless steel 304 for a brake drum will be done. Steady state condition are studied. Transient state analysis, for regular 30 seconds, 90, 120 and 210, temperature distribution and thermal flux is studied. A comparison of all the three results is done and aluminium alloy material is proved better than the other materials

[3] Meenakshi Kushal

The aim of this paper is to optimize the design of Hero Honda Passion brake drum. Optimization is done by changing the material of the brake drum, under different braking time and operational conditions. Brake drum is optimized to obtained different stresses, deformation values, rise in temperature on different braking time and heat transfer rate. Optimized results obtained are compared for Aluminium and CE (Controlled Expansion) material alloys. It concludes that the CE (Controlled Expansion) alloys can be a better candidate material for the brake drum applications of light commercial vehicles and it also increases the braking performance.

[4] Liu Hongpu

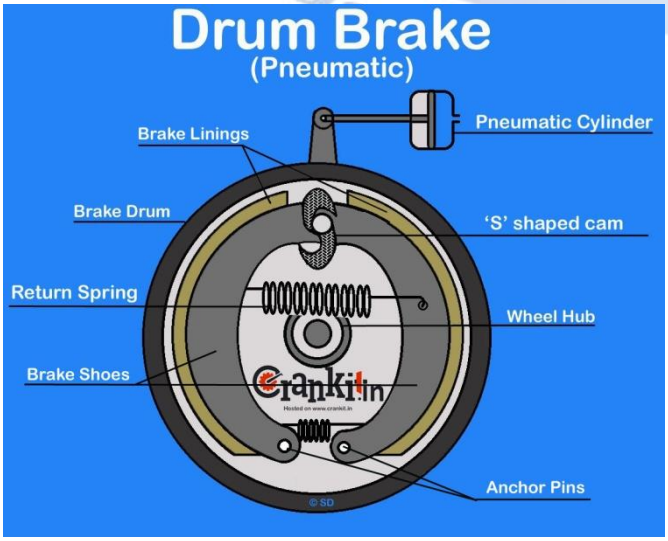
This paper describes the design and study on the type parameter of the brakes. On the basis of the principles of discretization, discretize the structural pattern of the brake drum. Select the typical characteristic of the brake assemblies and the individual parts of the 3d parameterization modeling work, to build a model for parameterization library calls.

3.DESIGN OF DRUM BRAKES

Rear drum brakes are typically of a leading design (for non-servo systems), or primary/secondary (for duo servo systems) the shoes being moved by a single double-acting hydraulic brakes and hinged at the same point. In this design, one of the brake shoes always experiences the self-applying effect, irrespective of whether the vehicle is moving forwards or backwards.

This is particularly useful on the rear brakes, where the parking brake (handbrake or footbrake) must exert enough force to stop the vehicle from travelling backwards and hold it on a slope. Provided the contact

area of the brake shoes is large enough, which isn't always the case; the self applying effect can securely hold a vehicle when the weight is transferred to the rear brakes due to the incline of a slope or the reverse direction of motion. A further advantage of using a single hydraulic cylinder on the rear is that the opposite pivot may be made in the form of a double-lobed cam that is rotated by the action of the parking brake system. Front drum brakes may be of either design in practice, but the twin braking design is more effective. This design uses two actuating cylinders arranged so that both shoes use the self-applying characteristic when the vehicle is moving forwards. The brake shoes pivot at opposite points to each other. This gives the maximum possible braking when moving forwards, but is not so effective when the vehicle is traveling in reverse. The optimum arrangement of twin braking front brakes with leading brakes on the rear allows more braking force at the front of the vehicle when it is moving forwards, with less at the rear. This helps prevent the rear wheels from locking up, but still provides adequate braking at the rear. The brake drum itself is frequently made of cast iron, though some vehicles have used aluminum drums, particularly for front-wheel applications. Aluminum conducts heat better than cast iron, which improves heat dissipation and reduces fade. Aluminum drums are also lighter than iron drums, which reduces un spring weight. Because aluminum wears more easily than iron, aluminum drums frequently have an iron or steel liner on the inner surface of the drum, bonded or riveted to the aluminum outer shell.



4.MATERIAL SELECTION FOR DRUM

Traditional material for automotive brake rotor is the cast iron. The specific gravity or density of cast iron is higher which consumes much fuel due to high inertia. Following section will describe the potential candidate materials those can be used for brake rotor application. Based on the properties, potential candidate materials for automotive brake disc were selected as:

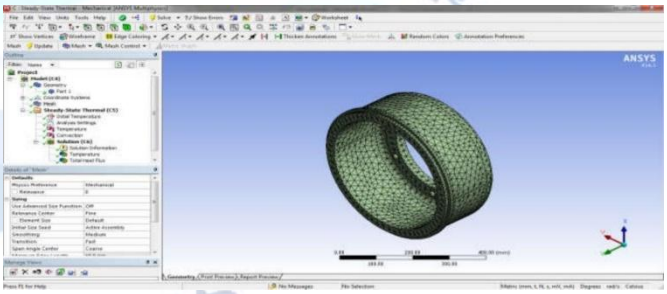
- Gray cast iron (GCI)
- Ti-alloy (Ti-6Al-4V)

7.5 wt% WC and 7.5 wt% TiC reinforced

- Ti-composite (TMC) 20% SiC reinforced Alcomposite (AMC 1)
- 20% SiC reinforced Al-Cu alloy (AMC 2)

5. SOLID WORKS DIAGRAM

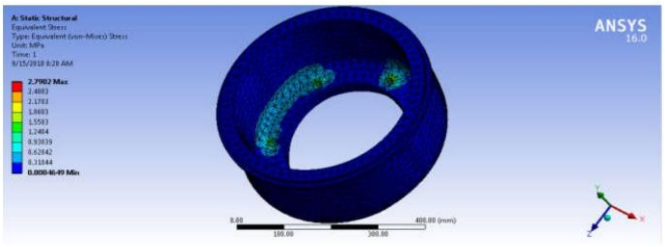
MESHING

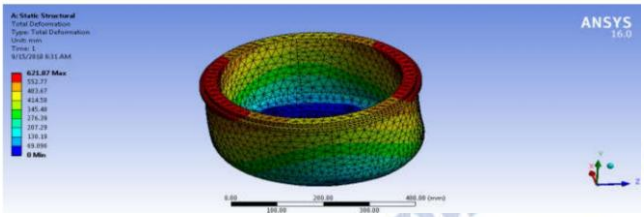


MATERIALS AND THEIR PROPERTIES

material	Density (kg/m^3)	Young's modulus (MPa)	Poisons ratio	Thermal conductivity(w/mm^0c)
Aluminum oxide	3720	3e005	0.21	2.5e-002
AlSiC	2880	1.15e011	0.27	0.2256
Aluminum alloy	2770	7.1e003	0.33	0.175
Grey cast iron	7200	1.1e005	0.28	5.2e-002

ANALYSIS OF EQUIVALENT STRESSES





TOTAL DEFORMATION IN ANSYS WORKBENCH

6. CONCLUSION:

The use of finite element analysis in product design Validation has been explored in this research work. Computer Aided Analysis was employed to determine the Structural integrity and thermal effects using Finite Element method on motorcycle drum brake and brake pad. The result of the analysis using ANSYS software showed.

- Modeling and analysis of drum brake and brakepad is done.
- Using solid works software with various commands.
- These components are modeled Then the file is saved as IGS to import in Ansys software.
- The drum brake model is imported to Ansys 16.0 work bench software.
- Thermal analysis at 119°C and Structural analysis at 2610N force with four different materials such as Aluminum alloy, Grey cast iron, aluminum oxide, Aluminum silicon carbide is done.
- Structural deformations such as stress,deformation, strain and Thermal calculations of temperature distribution and total heat flux are found and tabulated.
- Similar to that Static analysis of brake pad with three different materials such as Alumina, Zirconia, Cfrp materials is done.
- Structural deformations such as stress, deformation and strain are found and tabulated.

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